DECISION DOCUMENTATION PACKAGE
COVER SHEET

prepared in accordance with

TRACK 1 SITES:
GUIDANCE FOR ASSESSING
LOW PROBABILITY HAZARD SITES
AT INEL

Site description: **LOCATION OF REMOVED UNDERGROUND STORAGE TANK (PBF-752)**

Site ID: PBF-31 Operable Unit: 5-12

Waste Area Group: 5 Document Date: November 10, 1995

I. SUMMARY - Physical description of the site:

Power Burst Facility (PBF)-752 was a single walled, tar-coated steel 2,000 gallon heating oil tank located on the east side of building PBF-612 at the Waste Engineering Design Facility (WEDF). The tank was installed in 1960 and supplied heating fuel to Building PBF-612 until 1994 when it was removed and replaced with (PBF-774) a 2,500 gallon, fiberglass reinforced plastic tank by the underground storage tank (UST) program.

Calculations done in 1993 indicated a loss from this tank of 1328 gallons of fuel over a six month period. This quantity equates to approximately 221 gallons of fuel used per month during summer months when the heaters would not have been likely to have run very frequently. No monitoring had ever been undertaken prior to this which would have measured fuel consumption or possible losses from this tank.

During removal in August 1994, the tank was discovered to have leaked an unknown quantity of fuel into the surrounding soils and underlying basalt bedrock. The construction contractor reported Total Petroleum Hydrocarbon (TPH) levels of 2,670 to 22,500 mg/Kg to EG&G and the DEQ (Division of Environmental Quality) after sampling the soils beneath the tank. DEQ directed the contractor to submit new samples for confirmation. When these were received they confirmed the initial results.
All contaminated soils were later removed from the site by the UST program, however fuel oil was observed to have penetrated the underlying basalt formation. This leakage to bedrock is the cause for the concern associated with the tank. The contaminated dirt and gravel was moved to the INEL landfill where it has been landfarmed in accordance with DOE-ID and State requirements.

DECISION RECOMMENDATION

II. SUMMARY - Qualitative Assessment of Risk:

There appears to be no excessive risk due to diesel contamination at this site.

All of the diesel contaminated soil has been removed from the site thereby eliminating the soil ingestion, dermal contact, and the soil gas inhalation pathways. Any diesel remaining at the site exists in the basalt bedrock which is more than 10 feet below land surface (bls) and could only present a possible groundwater hazard. The water table at this location is approximately 483 ft bls reducing the likelihood that the contaminant might reach groundwater.
The GWSCREEN model was used to calculate groundwater concentrations of diesel constituents which could result from twenty years of tank leakage at the maximum volumes reported in 1993. None of the constituents of the fuel (benzene, toluene, ethyl benzene, xylene, naphthalene, methyl naphthalene) would arrive at the water table in concentrations near their risk-based concentrations as presented in the DOE Track 1 guidance. Only the benzene component would arrive at the water table before 400 years and by then it would have physically degraded to approx. 1.31E-48 mg/Kg or effectively zero.

III. SUMMARY - Consequences of Error:

False Negative Error:

If the actual quantity of diesel released to the basalt beneath the tank is substantially greater than that used in estimates provided in this report, there would be potential risk that the benzene concentration would exceed the risk based concentration for groundwater ingestion. If models are incorrect there could be potential exposure by members of the public to the hazardous constituents of the fuel via the groundwater pathway. This is not likely since most of the constituents will have degraded by the time the diesel could reach the aquifer which is some 483 feet below land surface.

False Positive Error:

If further action is undertaken to address diesel contamination remaining at this site the funds expended would exceed the environmental benefit to the site. The modeled concentrations of hazardous constituents of the diesel, assuming leakage over a 20 year period, would be below the 10E-6 risk level by the time the fuel could reach groundwater. Groundwater ingestion would be the only available complete exposure pathway. Remedial action to attempt to capture the plume of diesel would be extremely costly and would not improve the protection of human health. The 10 foot cover of clean soil above the spill area, combined with natural degradation of the diesel and adsorption to interbed sediments will more than adequately reduce the increased risk of cancer to well below $10E^{-6}$, or 1 in 1 million.

IV. SUMMARY - Other Decision Drivers:
Previous Track 1 investigations for IET-10, and 11, which were similar to this site were determined to be No Further Action sites.
Depth to groundwater at this location was measured as 483 feet in a neighboring monitoring well. Eight zones of sedimentary interbed thickness total 134 ft (40 m) within this depth. This would create an extended travel time for any contaminant migrating towards the aquifer.

Although the Evaluation of Groundwater Impacts Resulting from Fuel Oil Leaks at Tanks PBF-742 and 752 (Attach 1) states that hydrocarbons could reach the aquifer in the free liquid organic phase in as little as 3.5 years the probability of this actually occurring is slim. This estimate was based upon a hydraulic conductivity value of 2.74E-3 cm/sec which is at the upper end of the distribution for interbed sediment values at the INEL. As exhibited in the attachment over 86% of hydraulic conductivity values for these sediments are considerably lower than this stated value. The likelihood that all 134 feet of interbed layers beneath the tank have uniform conductivity of 2.74E-3 cm/sec or greater is infinitesimal. Travel estimates based upon the 50th percentile value of hydraulic conductivities indicate that contaminants of this nature would be virtually immobilized when coming in contact with interbed geology.

A second factor confirming the unlikelihood of transit to the aquifer is the fact that no monitoring wells in the PBF/ARA area have shown evidence of diesel contamination. As stated in Attachment 16 the only detections of volatile organics in this collection of PBF monitoring wells were low levels of Methylene Chloride and toluene. The Methylene Chloride is a common lab contaminant and was also detected in the associated method blanks and the quality control samples. The toluene detection was an estimated value of 1 ug/L which is below the specified detection limit of 5 ug/L, and well below the maximum contaminant level of 1000 ug/L. Toluene is also recogized by the EPA as a common laboratory contaminant (Attach 17).

Recommended action:

PBF-31 should be classified as a No Further Action site. Risk associated with the diesel spill has been shown to be insignificant. Leaving the site as it is, is unlikely to have a negative impact upon the health of the public.

Signatures	# PAGES:	DATE:
Prepared By: D.B.Pollitt	**DOE WAG Manager: A.T. Jines**	
Approved By:	**Independent Review:**	

DECISION STATEMENT (by DOE RPM)	
Date received:	
Disposition:	
DATE:	# PAGES (decision statement):
NAME:	SIGNATURE:

DECISION STATEMENT (by EPA RPM)	
Date received:	
Disposition:	
DATE:	# PAGES (decision statement):
NAME:	SIGNATURE:

DECISION STATEMENT
(by IDHW RPM)

Date received:
Disposition:

DATE:	# PAGES (decision statement):
NAME:	SIGNATURE:

PROCESS/WASTE WORKSHEET
SITE ID PBF-31

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
Process: Fuel oil stored in an underground storage tank.	-Fuel leaked to the subsurface. -Calculations done on volume lost from the tank in 1993 indicated that leakage of 1328 gal of fuel had occurred. -The tank was filled periodically when fuel was transferred from truck to tank. From the tank it was pumped to building PBF-612 where it was burned to supply heat for the facility. -All accessible contaminated soil was removed and tank replaced. -Fuel was left in subsurface.	Artifact: Underground storage tank, and associated piping. Location: Now removed. Was adjacent to building PBF-612 at the WEDF. Description: 2,000 gallon capacity tar-coated single walled steel storage tank, and 2" and 3/4" steel piping.
		Artifact: Spilled fuel Location: Beneath tank bed, penetrating basalt bedrock. Description: Unknown quantity of diesel heating fuel
		Artifact: Tank contents Location: Pumped out prior to tank removal. Description: #2 diesel fuel.

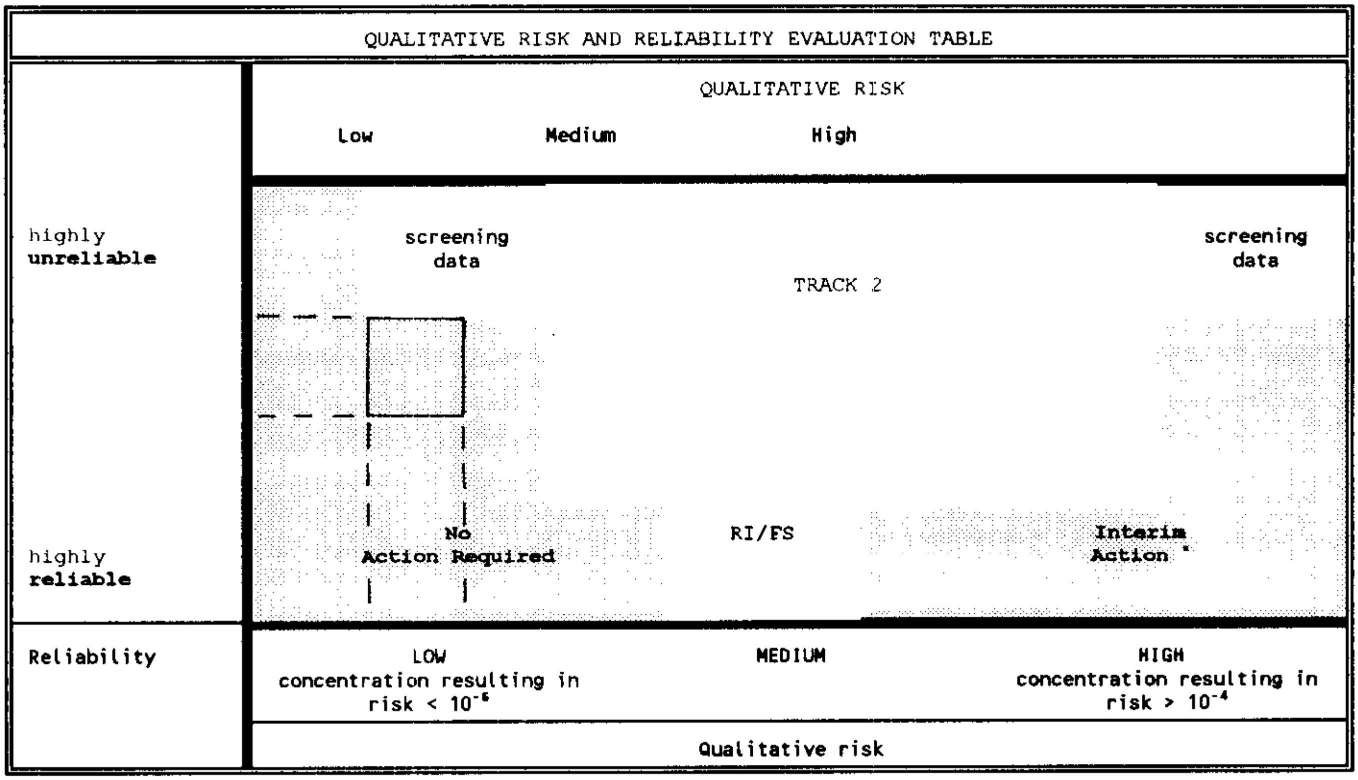
PROCESS/WASTE WORKSHEET
SITE ID PBF-31

Col 1 Processes Associated with this Site	Col 2 Waste Description & Handling Procedures	Col 3 Description & Location of any Artifacts/Structures/Disposal Areas Associated with this Waste or Process
		Artifact: Contaminated soil. Location: Surrounding the tank location. All contaminated dirt and gravel was removed from the excavation, and is being landfarmed at the INEL landfill. Description: Soil approximately 10 ft (11ft 3in indicated in field log) deep which surrounded the buried tank. Reading taken prior to sampling indicated 120-150ppm TPH in air. Lab results indicated between 2,670 and 22,500 mg/Kg TPH from soil samples.

CONTAMINANT WORKSHEET
SITE ID PBF-31
PROCESS (Col 1) Fuel storage tank WASTE (Col 2) #2 Diesel fuel

Col 4 What known/potential hazardous substances/constituents are associated with this waste or process?	Col 5 Potential sources associated with this hazardous material	Col 6 Known/estimated concentration of hazardous substances/constituents a	Col 7 Risk based concentration mg/L	Col 8 Qualitative risk assessment (Hi/Med/Lo) f	Col 9 Overall reliability (Hi/Med/Lo)
Total petroleum hydrocarbon	soil	22,500 mg/Kg. c	N/A d	low	med
Benzene	leakage to basalt	1.59E-48	0.0008	low	med
Toluene	leakage to basalt	0.00E+00	1.0	low	med
Ethyl benzene	leakage to basalt	0.00E+00	2.0	low	med
Xylene	leakage to basalt	0.00E+00	0.8	low	med
Naphthalene	leakage to basalt	2.68E-01	1.0	low	med
Methyl naphthalene	leakage to basalt	1.06E-01	nd e	nd e	n/a

a. Maximum concentration based on the Dragun model, except for TPH. Attachment 1.
b. DOE, Track 1 Sites:Guidance for assessing low probability sites at the INEL, 1994 Appendix D, Table II-1: based upon 10^{-6} carcinogenic risk or <1.0 hazard quotient.
c. Maximum concentration from soil samples. This soil has since been removed.
d. Not applicable since no EPA accepted toxicity values are available for TPH.
e. Not determined due to no available slope factors or reference doses.
f. Based upon conservative assessment of risk calculated in Attachment 1.



* If sufficient data exist to identify an appropriate remedy

Question 1. What are the waste generation process locations and dates of operation associated with this site?

Block 1 Answer:

Diesel oil was delivered by tanker truck to the location periodically. There are no records of spills occurring during any of these refilling events. The PBF-31 site was the location of PBF-752 a tar-coated steel 2,000 gallon capacity tank used to store diesel oil for the purpose of heating building 612 of the PBF facility. The tank was located at the Waste Engineering Development Facility (WEDF) East of building PBF-612, at a depth of approximately 10 ft bls. The tank was installed sometime during 1960 and remained in service until 1994 when it was removed as part of the INEL Underground Storage Tank Management Program. It was replaced with a 2,500 gal fiberglass reinforced plastic replacement tank (PBF-774). The UST was used to fuel a 75,000 BTU/hr. heating and ventilation unit.

Block 2 How reliable is/are the information source/s? _X_ High __ Med __ Low **(check one)**
Explain the reasoning behind this evaluation.

The information was obtained from the UST database, site maps, photos, field logbooks, and the tank removal summary.

Block 3 Has this INFORMATION been confirmed? _X_ Yes __ No **(check one)**
If so, describe the confirmation.

Engineering drawings and logbook excavation data confirm the tank location and purpose. The UST database confirms capacity and dates of operation. These are in agreement.

Block 4 Sources of Information **(check appropriate box(es) & source number from reference list)**

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]	10	Documentation about data	[ ]	
Historical process data	[ ]	5	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Areal photographs	[ ]	7	Safety analysis report	[ ]	
Engineering/site drawings	[ ]	6,8	D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]	13	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
Other	[ ]	9,12			

Question 2. What are the disposal process locations and dates of operation associated with this site?

Block 1 Answer:

No records indicate that the tank was ever used for waste disposal. PBF-752 was installed in 1960 for the purpose of storing diesel oil for use as heating fuel. The tank was used until August 1994 at which time it was replaced with a fiberglass reinforced plastic 2,500 gallon capacity tank. The tank was located to the east of building PBF-612, buried in approximately 10 feet of soil. Contamination of the soils and associated bedrock would have occurred due to failure of the tank walls. No records indicate holes observed during the removal of the tank.

Block 2 How reliable is/are the information source/s? _X_High __Med __Low **(check one)**
Explain the reasoning behind this evaluation.
The tank usage and removal dates are available in the UST database, while the locations are derived from site maps, photographs and the fact that the removal occurred at the specified location. The estimate of twenty years for disposal/leakage of oil is only moderate in its reliability since no monitoring was done until 1993. The expectation is that this would be an overestimate of the actual time of leakage.

Block 3 Has this INFORMATION been confirmed? _X_Yes __No **(check one)**
If so, describe the confirmation.

Tank usage dates, removal dates, and disposal dates were confirmed by UST records and field logbooks. Engineering drawings and project files confirmed tank size and purpose.

Block 4 Sources of Information **(check appropriate box(es) & source number from reference list)**

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]	10	Documentation about data	[ ]	
Historical process data	[ ]	5	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Areal photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]		Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
Other	[ ]	6,9,12			

Question 3. Is there evidence that a source exists at this site? If so, list the sources and describe the evidence.

Block 1 Answer:

Yes.
A source of contamination remaining at this site is inferred by the fact that diesel was observed to have leaked to the soil/bedrock interface. This leakage is assumed to have introduced a source volume of unknown magnitude to the basalt underlying the location of tank PBF-752. This observation indicated that diesel had reached basalt and could have access to the aquifer via the significant porosity and permeability of the formation. Volume and area of the source are strictly estimates.
Calculations done on fuel lost from the tank during the summer of 1993 indicated that at least 1328 gallons leaked to the surrounding soil and bedrock.
Soil samples taken from the bottom of the excavation indicate that diesel left the containment of the tank and had access to surrounding soil. Analytical data confirmed TPH concentrations in soil of 2,670 to 22,500 mg/Kg.
The old tank and all visibly contaminated soil were removed prior to installation of the replacement tank. Further excavation was impossible upon reaching the bedrock. This reduced any source volume to that contamination within the bedrock.

Block 2 How reliable is/are the information source/s? _X_ High __ Med __ Low **(check one)**
Explain the reasoning behind this evaluation.
Tank removal records indicate that all contaminated soil was removed from the site. These and the field logbook entries note the presence of oil at the soil/bedrock interface. Fuel losses are based on measurements of tank volume, and are fairly reliable for 1993. Lab data indicated levels of soil contamination.

Block 3 Has this INFORMATION been confirmed? _X_ Yes __ No **(check one)**
If so, describe the confirmation.
Tank removal has been confirmed by field logbooks and site photographs. Field screening PID readings were confirmed by laboratory analytical results. These were confirmed upon results of a second set of soil samples as requested by DEQ.

Block 4 Sources of Information **(check appropriate box(es) & source number from reference list)**

No available information	[ ]	______	Analytical data	[ ]	______
Anecdotal	[ ]	______	Documentation about data	[ ]	______
Historical process data	[ ]	3,4	Disposal data	[ ]	______
Current process data	[ ]	______	Q.A. data	[ ]	______
Areal photographs	[ ]	7	Safety analysis report	[ ]	______
Engineering/site drawings	[ ]	______	D&D report	[ ]	______
Unusual Occurrence Report	[ ]	______	Initial assessment	[ ]	______
Summary documents	[ ]	1,11	Well data	[ ]	______
Facility SOPs	[ ]	______	Construction data	[ ]	______
Other	[ ]	9,12,13,14,15			

Question 4. Is there empirical, circumstantial, or other evidence of migration? If so, what is it?

Block 1 Answer:

Yes.
There is empirical and circumstantial evidence that migration of the contaminant has occurred. Observations were made during excavation of the tank that fuel had leaked from the tank to the surrounding soils as well as reaching the basalt beneath the tank. Photo ionization detector (PID) readings taken during the removal indicated VOC levels consistent with hydrocarbon saturation (120 to 150ppm). Analytical results from soil samples taken from beneath the tank indicate high levels of TPH contamination (2,670 to 22,500mg/Kg TPH diesel). No evidence is available which indicates migration of the diesel in the vadose zone or to groundwater beneath the tank, since no samples have been collected from the basalt and no nearby wells have detected increases in hydrocarbon contamination.

Block 2 How reliable is/are the information source/s? _X_High __Med __Low (check one)
Explain the reasoning behind this evaluation.
Field notes of visual observations and PID readings indicating migration of fuel within the soil are reliable. Results of laboratory analysis are reliable in showing the amount of TPH which has moved from the tank to the surrounding soil.

Block 3 Has this INFORMATION been confirmed? _X_Yes __No (check one)
If so, describe the confirmation.
Laboratory analysis confirms the presence of hydrocarbons in the soil as was indicated by PID readings and visual indicators. A second set of samples was submitted to the lab which confirmed the initial TPH readings.

Block 4 Sources of Information (check appropriate box(es) & source number from reference list)

No available information	[ ]		Analytical data	[ ]	12
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Areal photographs	[ ]	7	Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
Other	[ ]	12,13,14,15			

Question 5. Does site operating or disposal historical information allow estimation of the pattern of potential contamination? If the pattern is expected to be a scattering of hot spots, what is the expected minimum size of a significant hot spot?

Block 1 Answer:
The expected pattern of contamination around the tank would be a plume with the highest concentrations nearest the tank. The samples with the highest readings of TPH were taken from both the north and south ends of the tank. Those soils surrounding the tank which had absorbed diesel have been removed, but the amount of product which managed to reach the basalt is unknown. The pattern for migration in basalt is uncertain due to inhomogeneous porosity of the rock. The area and volume of the source in basalt cannot be accurately known without knowledge of the quantity of fuel actually lost from the tank.
The data provided in Attachment 3 derived the leakage rate for a six month period during the final year of operation by determining the number of gallons lost between April and October 1993. Tank leakage over a period of twenty years was assumed in modeling a hypothetical release in order to maintain a conservative approach. It was also assumed that the maximum quantity of fuel loss measured in 1993 was lost each year for the last twenty years of tank life. Attachment 1 evaluates risks due to the hypothetical release of 221 gallons per month from 1974 through 1994. The total quantity of fuel released in this scenario would be 2.04E+05 liters (>53,000 gal).

Block 2 How reliable is/are the information source/s? __High _x_ Med __Low **(check one)**
Explain the reasoning behind this evaluation.
The volume of diesel lost from the tank is an estimate. The volume lost during the summer of 1993 is reliable, but losses during previous years are unknown. Potential exists for no leakage to have occurred in any year prior to 1993, but it is more likely that small quantities began to be lost by the tank sometime well into it's lifespan. The quantities would probably have increased as the integrity of the tank declined.
A plume of diesel surrounding the tank was present as indicated by field screening by PID instruments, observation, and laboratory results from soil samples.

Block 3 Has this INFORMATION been confirmed? _X_ Yes __No **(check one)**
If so, describe the confirmation.
The laboratory data from soil samples confirmed that TPH diesel contamination above the TMP guideline was present in the excavation. The samples were rerun a second time to confirm the initial results.

Block 4 Sources of Information (check appropriate box(es) & source number from reference list)

No available information	[ ]		Analytical data	[ ]	12
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]	3,4	Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Areal photographs	[ ]	7	Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
Other	[ ]	11,13			

Question 6. Estimate the length, width, and depth of the contaminated region. What is the known or estimated volume of the source? If this is an estimated volume, explain carefully how the estimate was derived.

Block 1 Answer:

Figure 1 in Attachment 1 provides a reasonable conceptual model diagram for the existence of diesel in the subsurface beneath PBF-31. Two different models were utilized to estimate the volume and geometry of the contaminated regions. These resulted in estimated contaminated soil volumes of $2609 m^3$ ($3413 yd^3$), and $3728 m^3$ ($4876 yd^3$) for the Dragun and HSSM (Hydrocarbon Spill Screening Model) models respectively.
The conceptual models presume that the contaminated region is square in shape in order to avoid the complexity of circular area calculations. The GWSCREEN model only allows rectangular sources even though radial spreading of hydrocarbons would be more realistic. The Dragun and HSSM models estimate areas of 2.99E+08 cm^2 or 6.90E+09cm^2 for the contaminated interbed. These areas correlate to square regions with sides of 173m. or 830m., and depths of 7.69cm. or 0.54cm. for the Dragun and HSSM models respectively.

Block 2 How reliable is/are the information source/s? __High_x_Med __Low **(check one)**
Explain the reasoning behind this evaluation.
The volume and dimensions provided are only an estimate based upon a number of assumptions such as the twenty year period of leakage. The information is provided in Attachment 1.

Block 3 Has this INFORMATION been confirmed? __Yes _x_No **(check one)**
If so, describe the confirmation.
These parameters can not be confirmed without visual or other evidence.

Block 4 Sources of Information **(check appropriate box(es) & source number from reference list)**

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Areal photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
Other	[ ]				

Question 7. What is the known or estimated quantity of hazardous substance/constituent at this source? If the quantity is an estimate, explain carefully how the estimate was derived.

Block 1 Answer:

The known quantity of fuel leaked from the tank was 1328 gallons of fuel lost between April and October 1993 recorded by the facility engineer. This equates to 221 gal/mo. This release rate was converted to a metric measure of 27.88283 Liters/day. This figure was multiplied by 365 d/yr and then multiplied by 20 years to account for ½ the time the tank was in operation. The resultant quantity would be approximately 203,545 liters, or approximately 53,776 gallons for the 20 year period.

Attachment 1 evaluates risks due to the hypothetical release of 221 gallons per month from 1974 through 1994. The total quantity of fuel released in this scenario would be 2.04E+05 liters (>53,000 gal.).

Block 2 How reliable is/are the information source/s? __High__Med_X_Low **(check one)**
Explain the reasoning behind this evaluation.
No monitoring of consumption or possible leakage was done prior to 1993, therefor the amount of fuel lost from the tank and how many years the leakage occurred is unknown. The hypothetical model utilizes the volume lost for 1993 and presumes that leakage of this same amount occurred for the approximate twenty year half-life of the tank.

Block 3 Has this INFORMATION been confirmed? __Yes _X_No **(check one)**
If so, describe the confirmation.

Block 4 Sources of Information **(check appropriate box(es) & source number from reference list)**

No available information	[ ]		**Analytical data**	[ ]	
Anecdotal	[ ]		**Documentation about data**	[ ]	
Historical process data	[ ]	3,4	**Disposal data**	[ ]	
Current process data	[ ]		**Q.A. data**	[ ]	
Areal photographs	[ ]		**Safety analysis report**	[ ]	
Engineering/site drawings	[ ]		**D&D report**	[ ]	
Unusual Occurrence Report	[ ]		**Initial assessment**	[ ]	
Summary documents	[ ]	1	**Well data**	[ ]	
Facility SOPs	[ ]		**Construction data**	[ ]	
Other	[ ]				

Question 8. Is there evidence that this hazardous substance/constituent is present at the source as it exists today? If so, describe the evidence.

Block 1 Answer:
Yes. Although all of the contaminated soil which could have been a source was removed following tank excavation, diesel from the tank leak was observed to have penetrated the basalt. and begun to migrate to the groundwater. The contaminant concentrations within the resulting plume would diminish over time and distance due to dilution by solvent, adsorption to sediments in interbeds, and degradation of volatiles. Concentrations predicted in the calculations in Attachment 1 were all below any of the risk-based concentrations, or the maximum contaminant limits (MCL) for the constituents of #2 diesel fuel. According to this model toluene, ethyl benzene, and xylene decayed to zero before reaching the aquifer, while only an extremely small amount of benzene (1.31E-48 mg/Kg) remained after transport in the unsaturated zone. Naphthalene and methyl naphthalene reached the aquifer but are well under risk-based concentrations, and reach maximum concentrations at the water table only after 3,000 and 19,000 years respectively.

Block 2 How reliable is/are the information source/s? __High _x_ Med __Low **(check one)**
Explain the reasoning behind this evaluation.
These models are well accepted, but they are tools which require numerous assumptions to be made in order to run. No data is available showing contaminant concentrations in the groundwater or interbeds.

Block 3 Has this INFORMATION been confirmed? __Yes _x_ No **(check one)**
If so, describe the confirmation.

Block 4 Sources of Information **(check appropriate box(es) & source number from reference list)**

No available information	[ ]		Analytical data	[ ]	
Anecdotal	[ ]		Documentation about data	[ ]	
Historical process data	[ ]		Disposal data	[ ]	
Current process data	[ ]		Q.A. data	[ ]	
Areal photographs	[ ]		Safety analysis report	[ ]	
Engineering/site drawings	[ ]		D&D report	[ ]	
Unusual Occurrence Report	[ ]		Initial assessment	[ ]	
Summary documents	[ ]	1	Well data	[ ]	
Facility SOPs	[ ]		Construction data	[ ]	
Other	[ ]	11,13			

REFERENCES

1. Rood, A.S. An Evaluation of Groundwater Impacts Resulting from Fuel Oil Leaks at Tanks PBF-742 and 752., July 5, 1995.

2. EG&G Idaho, Inc. Well Fitness Evaluation for the Idaho National Engineering Laboratory vol. 4, June 1993, (selected pages).

3. Interoffice communication from A. P. Wilson to V. E. Halford regarding leakage estimates from tanks PBF-742 and 752, Sept. 13, 1994.

4. Memorandum of conversation between J. Holdren and A. P. Wilson regarding estimates of tank leakage, May 25, 1995.

5. INEL UST database, Jan 23, 1995, pp. 44-45.

6. Maps showing location of PBF-31 site.

7. Photographs (4) of excavation dated August 11, 1994.

8. Section from engineering drawing #445591 'WEDF Heating and Ventilation Plan'

9. MK-FIC surveillance report verifying UST removal & disposal conducted August 4 1994

10. MK-FIC facsimile of Reed report from N. E. Lewis to T. Priestly, August 2, 1994.

11. New Site Identification form for PBF-31, with map of site, October 4, 1994.

12. Facsimile from N. E. Lewis to V. E. Halford September 7, 1994 with attached Construction Interface Document, Chain of custody, lab results, photos, and communication from PBF landlord.

13. Letter from S. L. Madson, DOE-ID, Office of Program Execution to C. Reno IDHW-DEQ, "Release of Petroleum Products from PBF 752 and PBF 742 - (OPE-SP-94-322)"

14. Facsimile from A. T. Jines to V. E. Halford regarding PBF-752 removal chronology.

15. Letter from S. D. Palomo, DOE-ID, to K. Reno, IDHW-DEQ, "Corrective Action at PBF-752 Request for Approval"

16. Groundwater Monitoring Well Sampling Data from ARA/PBF in Support of OU5-08 and 5-09 Track 2 Summary Reports, selected pages.

17. Risk Assessment Guidance for Superfund vol. 1, Human Health Evaluation Manual (part A), pp.5-16,5-30

ATTACHMENT 1

An Evaluation of Groundwater Impacts Resulting from Fuel Oil Leaks at Tanks PBF-742 and 752

Arthur S. Rood
July 5, 1995
Revised November 7, 1995

Introduction and Background

Two fuel oil storage tanks located at the Power Burst Facility identified as PBF-742 and PBF-752 were excavated during the tank replacement effort in 1994 and found to be leaking fuel oil. During excavation of these tanks, hydrocarbon contamination was detected in backfilled soil. This soil was removed and replaced with clean soil, but it was observed that the soil/basalt interface was saturated with fuel oil from these tanks.. A. P. Wilson, (EG&G Idaho, September 13, 1994) indicated that fuel oil had been leaking as noted by the change in the tank inventory from April, 1993 to October, 1993. The potential exits for migration of hydrocarbons beyond the backfilled soil to the unsaturated zone and eventually to the groundwater. This paper documents the potential impacts to groundwater resulting from releases of fuel oil from these two tanks.

Table 1. Tank capacities and estimated release rates.

Tank	Capacity (gal)	Capacity (L)	Estimated Release Rate (gal/month)[a]	(L/day)	(g/d)	Total Release (L)
PBF-742	1000	3785	72.5	9.147083	7775.021	6.7E+04
PBF-752	2000	7570	221	27.88283	23700.41	2.04E+5

(a) calculated by A. P. Wilson, 9/13/94

Table 2. No 2. diesel fuel components and release rate estimates.

Constituent	% by mass	Estimated Release Rate PBF 742 (g/d)	PBF 752 (g/d)	Total (20 years) PBF 742 (g)	PBF 752 (g)
Benzene	0.02	1.555004	4.7400817	1.14E4	3.47E4
Toluene	0.5	38.8751	118.50204	2.85E5	8.67E5
Ethyl benzene	0.5	38.8751	118.50204	2.84E5	8.67E5
Xylene	0.5	38.8751	118.50204	2.84E5	8.67E5
Naphthalene	0.6	46.65013	142.20245	3.41E5	1.04E6
Methyl naphthalene	1.5	116.6253	355.50613	8.54E5	2.60E6

Tank capacities and estimated release rates are presented in Table 1. The fuel oil stored in the tanks was assumed to be similar to No. 2 Diesel Fuel with a constituent percentage as listed in Table 2. The list of significant constituents was based on a previously unpublished analysis by James McCarthy on the CFA-721 and CFA-605W underground storage tanks, dated February, 1995. Estimated releases were assumed to occur over a 20 year period at this same release rate as calculated by A. P. Wilson. This time (20 years) represents about half the time the tanks were in operation at the site.

Methods and Conceptual Model

Groundwater pathway calculations were performed using the GWSCREEN model, Version 2.03 (Rood, 1994). Before these calculations were performed however, the volume and geometry of interbed contaminated with hydrocarbons was first defined. Several methods were used for making this determination. Dragun (1988) presents several, simple first-cut approximations to estimating hydrocarbon spill areas and volumes and these methods have been incorporated in previous INEL evaluations involving hydrocarbon spills. An alternative is to use other models that treat liquid organic phase transport explicitly. One such model is the Hydrocarbon Spill Screening Model (HSSM, EPA, 1994). Part of this exercise was to compare the methods described by Dragon, to the more sophisticated treatment of liquid organic phase transport incorporated in the HSSM model.

The conceptual model is illustrated in Figure 1. The tanks are assumed to lie directly on the soil/basalt interface. Some of the hydrocarbons are absorbed in the surrounding soil, but the majority of the release moves through the basalt relatively rapidly and infiltrates the interbed. The interbed thickness (40 m) was based on the interbed thickness determined in well number, SPERT-1. There are numerous interbeds noted in the cross section but for modeling purposes, these interbeds are treated as one. Travel time through the basalt is assumed to be relatively instantaneous. Hydrologic properties of the interbed were taken from the Track 1 document (DOE, 1992) and the GWSCREEN users manual (Rood, 1994). These properties include a saturated hydraulic conductivity of 23.9 m/y (7.58×10^{-5} cm/s), a residual water content of 0.142, a porosity of 0.487, and the van Genuchten fitting parameters of α (1.066 m^{-1}) and n (1.523). An infiltration rate of 0.1 m/y was assumed per TRACK 1 guidance which results in a volumetric moisture content of 0.3. The groundwater transport parameters, pore velocity (570 m/y), aquifer porosity (0.1), and transverse and longitudinal dispersivity (4 m and 9 m) were also taken from the TRACK 1 manual.

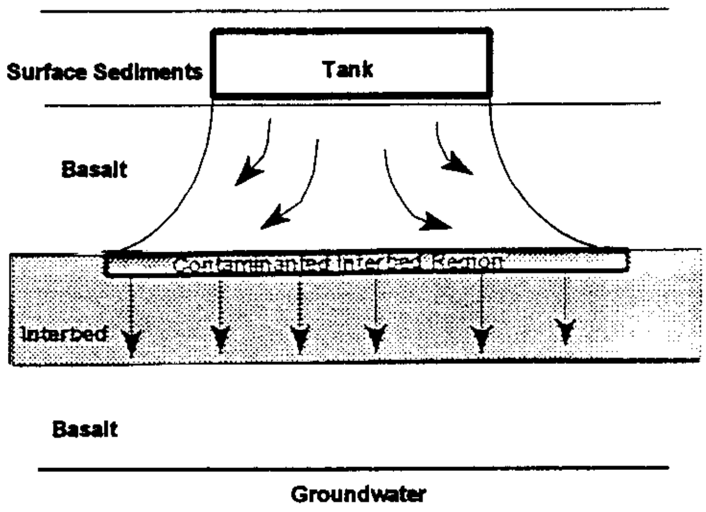


Figure 1. Conceptual model for hydrocarbon tank leak and transport in basalt and interbed.

The volume of the interbed contaminated by the hydrocarbon can be estimated using the following equation in Dragon

$$V_c = \frac{0.2 V_{HC}}{\theta \, RS} \tag{1}$$

where V_c = the volume of contaminated sediments (yd^3), V_{HC} = the volume of spilled hydrocarbon (barrels, 1 barrel = 44 gal, 1 gal = 3.785 L), θ = the soil porosity, and RS = the residual saturation. The value for RS recommended by Dragun for diesel and fuel oil is 0.15. For PBF-742 the volume of interbed sediments contaminated was 855 m^3. The volume of interbed sediments contaminated using the HSSM model was not computed directly, and was calculated outside the code. HSSM gives the maximum depth of penetration (0.0054 m) and the oil saturation (0.1124) value. The volume of contaminated soil is given by equation 1, replacing V_{HC} in barrels with V_{HC} in m^3, omitting the 0.2 value, and setting RS to 0.1124. Using these values results in a contaminated soil volume of 1223 m^3 for the 742 tank. The values are reasonably close considering the crude approximation of the Dragun equation.

The area of contamination can be grossly estimated using (Dragun, 1988)

$$A = 53.5\ (V_{HC})^{.89} \tag{2}$$

where A = the area of contamination in m^2 and V_{HC} is in barrels. The area of contamination for the HSSM simulation is calculated using

$$A = \frac{V_{HC}}{D\,\theta\,RS} \tag{3}$$

where A = the area of contamination (m^2) and D = the depth of penetration (m). The areas, volumes, and dimensions of the contaminated sediments are presented in Table 3 for both the HSSM model results and those using the equations in Dragun (1988). The area was assumed to be a square area source because GWSCREEN only allows rectangular sources (no circular source geometries). In reality, the hydrocarbons would probably spread radially forming a roughly circular area source. While the volumes of contaminated interbeds are close, the areas of contamination differ significantly. The Dragun equations were designed only to be a crude approximation and do not consider any site-specific soil properties as does HSSM. For this evaluation, the Dragun equations provide at least a bounding estimate of the contaminated area. The depth of contamination can be estimated using the Dragun equations and dividing the volume contaminated by the contaminated area. For the 742 tank, the depth of contamination was 855 m^3 / 1,1121 m^2 = 0.0769 m or 7.69 cm. This depth is considerably larger than the depth calculated by HSSM of 0.54 cm. Depth calculations are sensitive to interbed hydrologic properties in the HSSM model. These properties, particularly the hydraulic conductivity, are known to vary by many orders of magnitude in the interbeds and this in turn significantly affects the penetration depth of the liquid organic phase (see Figure 2).

Table 3. Area , volumes, and dimensions of the contaminated interbed.

Tank	Model	Area (cm^2)	Length of one side (m)	Volume Contaminated (m^3)
PBF-742	HSSM	2.27E+09	475	1223
PBF-752	HSSM	6.90E+09	830	3728
PBF-742	Dragon	1.11E+08	105	856
PBF-752	Dragon	2.99E+08	173	2609

For example, an HSSM simulation was run using an interbed sample (sample D49) with a measured hydraulic conductively (2.74E-3 cm/s) on the upper end of the distribution of hydraulic conductivity values reported for interbed sediments (McCarthy, 1995)[α=0.0493 cm^{-1}, n=1.299].

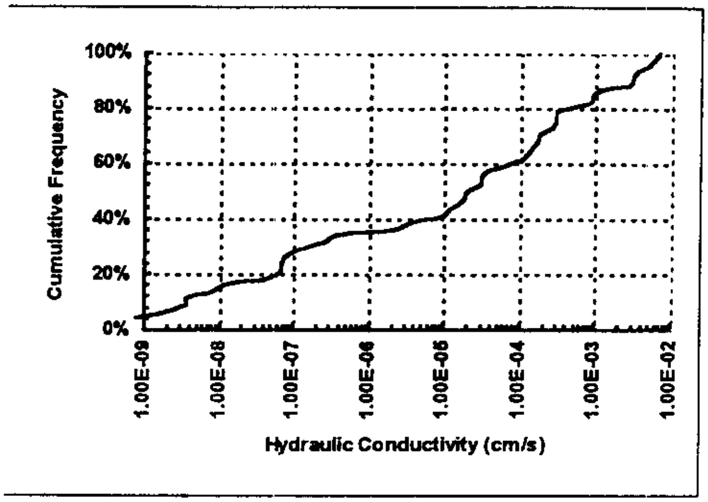


Figure 2 Cumulative frequency distribution of interbed hydraulic conductivities.

For the 20 year release, the hydrocarbon was predicted to reach the aquifer in the free liquid organic phase in 3.5 years. This scenario is less probable because about 80% of the interbed hydraulic conductivities are less than this value. The value of hydraulic conductivity used in the base case is a more reasonable value because if falls around the 50th percentile range (Figure 2).

Table 4. Constituent properties

Constituent	Risk-based[a] Concentration (mg/L)	Maximum Contaminant Limit[a] (mg/L)	Solubility[b] (mg/m^3)	K_{oc}[c] (mL/g)	K_d (mL/g)	Half-Life[d] (years)
Benzene	.0008	.005	1.75E+06	83	0.249	2
Toluene	1.0	1.0	5.35E+05	300	0.9	0.1
Ethyl benzene	2.0	0.7	1.52E+05	1100	3.3	1
Xylene	0.8	10	1.98E+05	240	0.72	1
Naphthalene	1.0	--	3.17E+04	1300	3.9	0
Methyl naphthalene	nd	nd	2.54E+04	8500	25.5	0

(a) DOE, 1994, Appendix D, Table II-1 ; based on 10^{-4} carcinogenic risk or <1.0 hazard quotient.
(b) EPA, 1990
© DOE, 1994 and EPA, 1990, Table A-1
(d) Howard et al., 1991
nd = not determined due to no available slope factors or reference doses

The next part of the problem was to model the dissolution of major constituents in the fuel oil to percolating pore water and the subsequent transport of this water to the aquifer. In this problem, the solubilities of each of the constituents were considered along with the their sorptive properties (Table 4). Organic carbon distribution coefficients were converted to K_d (soil-water partition coefficients) by multiplying the organic partition coefficient (K_{oc}) by the fraction of organic carbon (foc). The default TRACK 1 value for foc is 0.3%. First-order degradation was also considered. The constituent transport portion of the HSSM model was run and compared with the corresponding output from GWSCREEN. What was of interest was the movement of the constituent front through the interbed. HSSM output included the depth of the constituent front as a function of time. This output was compared to output that would be predicted by the GWSCREEN model. For this benchmark, a non-decaying contaminant having the same solubility and sorptive properties as benzene was used.

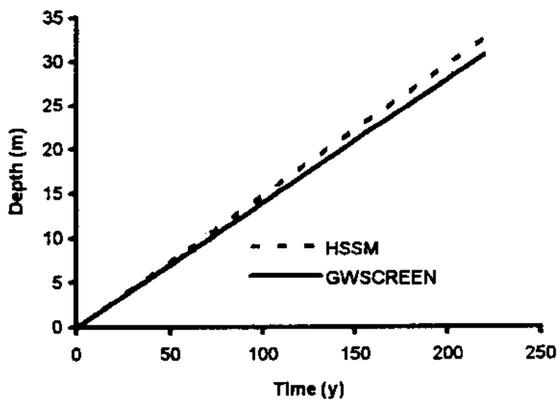


Figure 3. Depth of penetration of hypothetical constituent plume in unsaturated zone.

The contaminant velocity in the unsaturated zone as represented in GWSCREEN is easily estimated using the equation

$$V_c = \frac{I}{\theta\left(1 + \frac{K_d \rho}{\theta}\right)} \tag{4}$$

where I = infiltration (0.1 m/y), ρ = bulk density (1.5 g cm^{-3}), and θ = volumetric water content. Figure 3 shows a comparison of the two models for the hypothetical constituent considered. Note there is reasonably good agreement between the two models.

Results

A summary of the GWSCREEN output (Table 5) indicates none of the significant constituents had calculated groundwater concentrations greater than the risk-based concentrations or maximum contaminants limits stated in Appendix D, Table II-1 of the TRACK 2 Manual

(DOE, 1994) and listed in Table 4 (See Attachment A and B for GWSCREEN output). Groundwater concentrations were calculated for the HSSM source geometry and the source geometry using the Dragun equations. Concentrations are about a factor of 8-11 higher using the Dragun equations to define source geometry. For toluene, ethyl benzene, and xylene, zero concentrations were calculated in the aquifer because decay removed essentially all constituents before the contaminant front reached the aquifer. Very little of the benzene remained after transport in the unsaturated zone, therefore the aquifer concentrations were quite low. Only benzene arrives at the receptor well location before 400 years. Naphthalene arrives at around 3000 years and methyl naphthalene arrives after 10,000 years. Release of most of the constituents were not controlled by the constituent's solubility limit except for naphthalene.

Table 5. Maximum groundwater concentrations for a 20 year spill scenario for PBF-742 and 752 tanks using the HSSM and Dragun's equations to define source geometry.

Tank	Constituent	HSSM Maximum Concentration (mg/L)	Dragun Maximum Concentration (mg/L)	Maximum Contaminant Limit (mg/L)	Risked Based Concentration (mg/L)	Time of Maximum Concentration (years)
742	Benzene	1.03E-49	1.31E-48		.0008[b]	310
752	Benzene	1.002-49	1.59E-48		.0008[b]	310
742	Toluene	0.00E+00	0.00E+00	1.0		n/a
752	Toluene	0.00E+00	0.00E+00	1.0		n/a
742	Ethyl benzene	0.00E+00	0.00E+00		2.0[c]	n/a
752	Ethyl benzene	0.00E+00	0.00E+00		2.0[c]	n/a
742	Xylene	0.00E+00	0.00E+00		0.8[c]	n/a
752	Xylene	0.00E+00	0.00E+00		0.8[c]	n/a
742	Naphthalene	1.35E-02	1.68E-01		1.0[c]	3090
752	Naphthalene	1.35E-02	2.68E-01		1.0[c]	3100
742	Methyl naphthalene	5.19E-03	7.97E-02		nd[a]	19600
752	Methyl naphthalene	5.19E-03	1.06E-01		nd[a]	19600

(a) not determined
(b) based on 1 x 10^{-6} carcinogenic risk
© based on a hazard quotient of 1.0

These calculations indicate that there are limited impacts to groundwater from the spill. Given the variability in hydrologic properties of the interbeds, it is possible that the free liquid organic product may have migrated through the interbeds and into the aquifer. But this seems improbable because most of the interbeds sampled had relatively low hydraulic conductivities. Low hydraulic conductivity material would attenuate all of the free liquid organic product and prevent migration to the groundwater. Even if the free organic product penetrated the interbeds, most of the hazardous constituents (benzene in particular) will have significantly degraded by the time the product reached the aquifer and therefore, little impact would be observed. An analysis of this kind was not considered and is beyond the scope of this paper. A model, such as HSSM could be useful for such an analysis. The most recent version of the HSSM code and documentation have been requested from EPA and further analysis could be performed at this time.

References

DOE, 1992, *TRACK 1 Sites: Guidance for Assessing Low Probability Hazard Sites at the INEL.* DOE/ID-10340(92) Revision 1, U.S. Department of Energy, Idaho Field Office

DOE, 1994, *TRACK 2 Sites: Guidance for Assessing Low Probability Hazard Sites at the INEL.* DOE/ID-10389, Revision 6, U.S. Department of Energy, Idaho Field Office, January.

Dragun, J., 1988, *The Soil Chemistry of Hazardous Materials.* Hazardous Materials Control Research Institute, Silver Spring, Maryland.

EPA, 1990, *Basics of Pump-and-Treat Ground-Water Remediation Technology.* EPA/600/8-90/003, March.

EPA, 1994, *The Hydrocarbon Spill Screening Model (HSSM) Volume 1: User's* Guide. EPA/600/R-94/039a, April.

Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan, and E. M. Michalenko, 1991. *Handbook of Environmental Degradation Rates.* H. T. Printup, Editor.

McCarthy, J. M. SDA Hydraulic Characterization Data Compilation; Surficial Sediments and Interbeds. Idaho National Engineering Laboratory, Engineering Design File ER-WAG7-71, May 3, 1995.

Rood, A. S., 1994, *GWSCREEN, A Semi-Analytical Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination: Theory and User's Manual.* EGG-GEO-10797, Idaho National Engineering Laboratory, June.